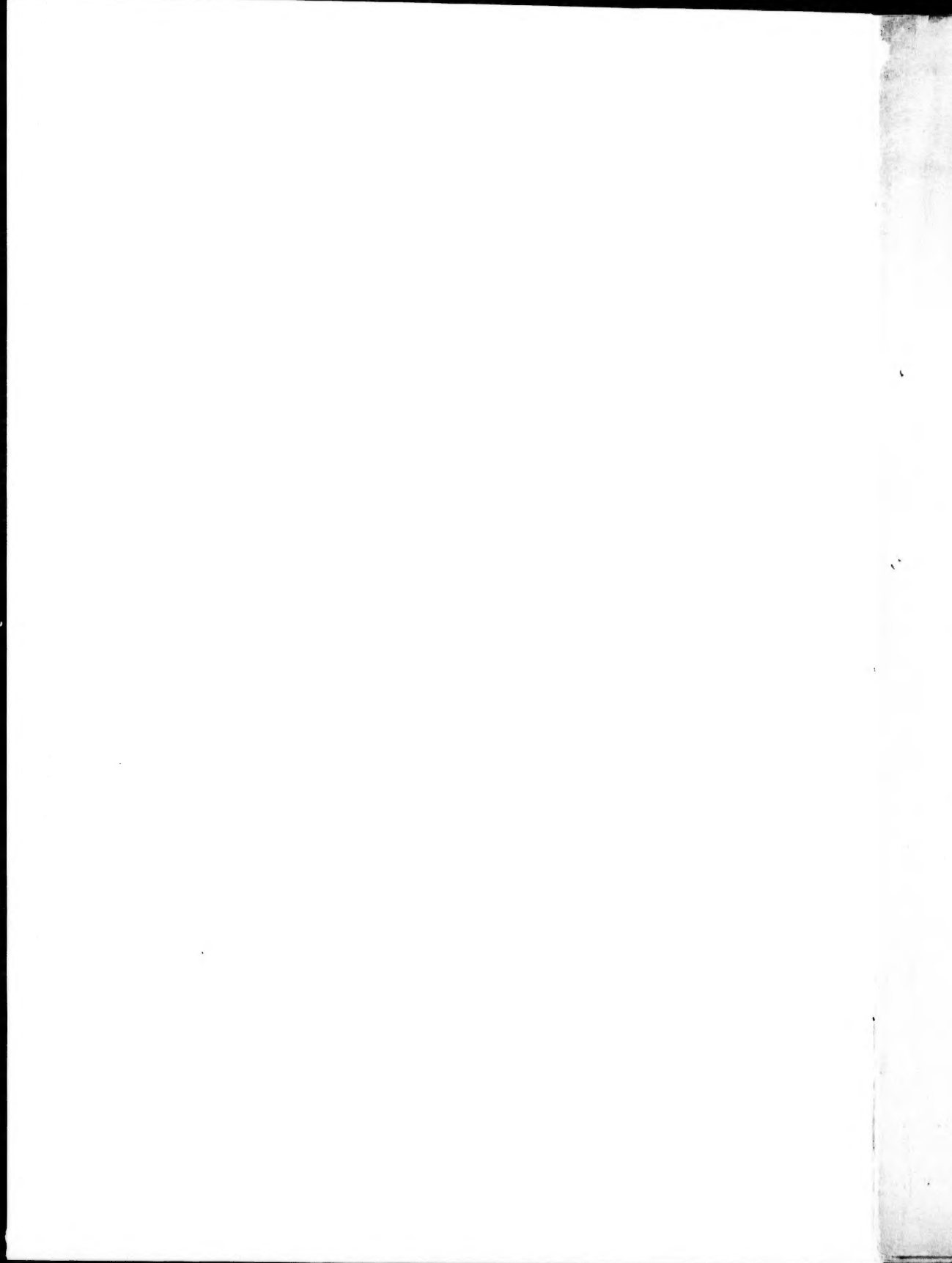




PAC NW
[Cariboo]
1879
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REPORT

ON THE

CARIBOO QUARTZ LEDGES.

BY MR. KOCH, MINING EXPERT.

PROVINCIAL SECRETARY'S OFFICE,
September 18th, 1886.

The following Report on certain quartz ledges in Cariboo is published for general information.

JNO. ROBSON,
Minister of Mines.

*To John Bowron, Esq.,
Gold Commissioner, Cariboo District.*

SIR,—At your request, on behalf of the Government, I have made as careful an examination of that portion of your mining district, lying within a radius of about six miles from Barkerville, as my time would admit of.

The time expended and expenses incurred are far in excess of the Government appropriations; but I became so deeply interested in the very encouraging outlook for the future, and the earnest anxiety of the residents of the district, together with the knowledge so fresh in my mind of the failure that was made in your laudable efforts to develop the quartz interests of the district during the year 1878, through the incompetency and jealousy of those under you, that I could not possibly terminate my survey with a cursory examination.

I, therefore, have the honour to submit the following:—

GEOLOGICAL FORMATION.

I find the formation identical with that of California. Slate predominates, with belts of limestone, porphyry, granite, and perhaps syenite; with stratification tending north and south, with variations north-west and south-east, showing a continuation of the formation of the gold-bearing belt of California.

The surface is somewhat broken and displaced, traceable, however, to glacial disturbances. The formation, I should say, was of the tertiary period; that, however, I shall leave for such eminent men as Professors Dawson, Bowman and others, to decide.

MINERAL-BEARING VEINS.

While a large amount was done, and money expended during the years 1878-9, but little has been done towards developing the veins. But two shafts have been sunk to a depth of 100 feet each, and several others 50 feet deep, while several tunnels have been run in on the veins, at a depth of from 20 to 80 feet from the surface; yet sufficient can be seen to come to the conclusion that many true fissure veins traverse the country, while even contact veins will, in my judgment, be discovered, as already evidenced. All veins prospected will not prove to

be permanent and paying veins; in fact, some of the prospects will prove, as in all countries, to be spurs or feeders to a true vein; or they may be slips, slides, or broken and detached pieces from true veins. In some cases they may be so encouraging to the prospector that much time and money may be expended on them before the fact is made plain that there is no vein, but only a feeder or detached mass.

To avoid such unhappy experience as far as possible, I will suggest a possible, or partial, remedy further on. (See Mineral Survey.) Most of the mines that have been prospected to any extent have a north-west and south-east trend, dipping towards the north-east.

While other veins deviate somewhat from that course, they also show well-defined walls and abundance of ore, notably the Island Mountain mines.

Breaks, or slips, have occurred on the veins on Island Mountain, as on other veins; but, so far as my examination extended, I think I am safe in saying that those slips and faults, as in other veins, do not extend to any great depth. The veins I have examined run from four and a half to twenty feet in width, while in some cases it is fair to presume that they are much wider than they seem; as, in some veins, so far developed, one wall is of a loose and broken nature, and may be only a stratum of slate interlined or separating one portion of the vein from another. In other words, a mine to all appearances carrying a vein of four and a half feet may, in reality, be a vein ten or more feet in width.

COURSE OF VEINS COMPARED WITH PLACER DIGGINGS.

In my topographical examination of the country, I could not help observing that, without exception, your extremely rich placers lay immediately below the quartz veins; as, for instance, if we start at the Lord Dufferin claim and follow the croppings passing the old Proserpine, now called the California, and continuing along the vein in a north-west course, you will find, immediately below, or at the base of the mountain to our left, runs Williams Creek, which has yielded many millions of gold, much of it extremely coarse, intermingled with quartz; while to our right, at the base of the same mountain, runs Conklin Gulch, which also yielded large quantities of gold, as, indeed, both places are yet doing.

Continuing along the course of the vein and crossing Williams Creek at the cañon until the summit going towards Lowhee is reached, we find Stout's Gulch lying to the left and below the vein. All know how extremely rich that gulch has been, while it is, even now, being hydrauliced far up the mountain side towards the vein. Following the vein over the summit dividing Stout's Gulch from Lowhee Creek, we find the latter has been rich; and within a very few days samples of heavy gold have been pounded out of quartz found while sluicing.

In the vicinity of the Pinkerton claim the vein crosses Lowhee Creek and pierces the mountain, continuing towards the Jack of Clubs Lake, taking in the Enterprise, now called the "Senator Jones," and extension, "Governor Perkins."

The vein, extending up and through the mountain, no doubt supplied Lowhee Creek with the coarse gold mentioned above; and as the vein crosses through the mountain, the gold found on the banks of the lake perhaps came from the same source.

I think I shall warn venturesome spirits from attempting to pump the lake out in their anxiety to find gold.

In continuing my survey, I find no source from which the rich diggings of Mosquito Creek derived their gold except from the large, well-defined, and continuous vein and cross-veins passing through Island Mountain. Returning to the Lord Dufferin, I was not surprised to find that Grouse Creek could not possibly have received its bounteous supply of gold from any other source than from the Bonanza vein, where it crosses Grouse Creek as it passes from the California claim and continues through the Lord Dufferin ground towards Antler Creek; and surely no one will question the source whence that creek derived its gold, when not a dollar is being mined above where the vein crosses either Grouse or Antler Creeks.

I find it impossible to embrace the Burns Mountain in this report; but from observation and information obtained from P. C. Dunlevy, of Soda Creek—a disinterested person, I think—I am led to think that the Burns Mountain veins supplied the millions mined from Lightning Creek, no gold being found above a point where Mr. Dunlevy supposed the veins crossed the creek.

While I may seem to have been somewhat exhaustive in my report on the above veins, I will say I have been shown samples of ore from what, at present, may be termed outside veins—notably the Steadman, Sergeant Lindsay, and other veins reaching so far away as Sugar Creek—and they, without exception, show well-defined walls, and invariably prospect well in

gold. Those on Sugar Creek, however, carry a higher percentage of silver than gold; and, beyond doubt, many veins exist not yet discovered. The country is thickly covered with weeds and moss, which makes prospecting or following veins somewhat difficult; but the day is not far distant, in my judgment, when many prospectors will be found busily engaged in uncovering good paying veins. Some will meet with success, while the dreams of wealth of others will, unhappily, never be realized. Such is too often the fate of the prospector, which can, in a measure, be palliated by the Government, as I will explain further on. (See Mineral Survey.)

I must not neglect to account for *supposed* veins carrying free gold, in some cases lying higher up the mountains than the true veins, which have but little free gold; notably one which was discovered high up—in fact, on the summit of the mountain above the B. C. mines.

During the glacial period all was chaos. The irresistible force did not always choose its course and destroy the tops of veins and carry them down to creeks below. On the contrary, portions of a vein were in some cases detached and carried many miles and landed on some mountain top hundreds of feet higher than its original bed, as in the case mentioned. Instead of being ground and crumbled sufficiently fine to admit of being gradually washed to the creeks below, it was carried in an unbroken mass and deposited on the top of the mountain, as is often seen in the case of a jam or drift of timber in a swollen stream, where trees may be seen piled up many feet, and beyond the line of the jam. In such cases the elements have but little effect on the supposed vein, and it lies there undisturbed, while thousands of tons broken and ground fine have at the same time been washed to the creeks below.

PAY CHUTES.

I find those interested in the development of the quartz veins somewhat surprised to learn that a gold quartz vein, found to be a paying one, should not continue paying to an indefinite depth and distance. In starting a tunnel, for instance, on a vein, the miner may have a vein that will pay a handsome profit above mining and milling expenses; that body of quartz may continue for twenty or perhaps five hundred feet; or the miner may, after drifting on the vein twenty or thirty feet, find he has come upon quartz that will not yield him one dollar per ton. I shall not advise him what to do in such a case, but will say that, in California, if his walls continued perfect, the miner would continue bravely on with his drift, testing his ore daily; and the chances are strongly in his favour of again drifting into a pay-chute which may continue hundreds of feet, and yield richer ore than he had hoped for. The same thing can be said of sinking shafts. The miner may start a shaft or incline on his vein and, as he sinks, to his chagrin he finds, while his quartz continues abundant, that only that portion covering half his shaft shows gold, and as depth is attained his pay-ore has disappeared entirely. And now, if he will stop and reason he will discover that he has sunk through his pay-chute, and he will either return to the point where he lost it and follow it, or continue his shaft as deep as he chooses, and then drift towards the course to which it dipped when he lost it.

I will instance the old Eureka mine of Grass Valley, California. A large amount of gold was taken from their pay-chute, which gradually dipped towards and to the Idaho claim, the owners of which claim then took possession, and it has produced millions; while they, in their turn, must, according to late advices, soon yield up the rich chute to the owners of the adjoining ground.

FREE GOLD AND SULPHURET VEINS.

I have been asked for an explanation why most of the gold quartz veins of California were free-milling on the surface, and why some of them continue so, while the veins of this district show mainly sulphuret ore?

I do not know that any scientific men have given a positive reason why such is the case, thus leaving me free to express my opinion on the subject, perhaps thereby drawing from a more scientific or practical engineer a better reason than I can give.

Lying so much further north than California, your country was that much more subject to the terrible effects of the glaciers which undoubtedly swept over this country in their course southward. Scientific men point out their effects in California, and why not I point out their effects here?

I am of the opinion that your veins here, at present, would have been worked hundreds of feet deep had they been attacked before the glacial period and worked to their present croppings. In other words, I think the veins were, originally, free-milling, and that the

original croppings stood hundreds of feet higher than the present level, and that the glaciers with their accompanying masses of rock, sweeping with wild and irresistible freedom, whirling and grinding through the country, have done for this country what stamp-mills have, to a great extent, done for California mines. I conclude that, with that powerful agency, the mountain tops, including the gold-bearing veins, were broken and ground down to the present level. The peaked snow-capped range lying to the north-east, and plainly in sight from the Proserpine Mountain, helps to bear me out in my theory, it being, I take for granted, a hard rocky range, perhaps granite, and much higher than the gold-bearing range, withstood the terrible charge from the far north much better than this range of mountains; yet even it has been battered against by some powerful agency, until its rocky spires reach, needle-like, far up into the clouds. If I am correct in my theory, we have accounted for the rich deposit of coarse gold intermingled with quartz found in the old and original bottoms of the creeks of the district; and while there is a difference of opinion as to whether more sulphurets were found in the old or the top channel, I find, from most reliable sources, that more were found in the top or present channel and side-hills than in the deep drifting claims, except in exceptional cases. That helps to bear me out in my theory that the tops of the veins were free-milling, that the glaciers ground and broke off the tops of the veins, deposited them in the creeks below with the gold in a rough and comparatively unwashed state, much of it being imbedded in quartz. The deposit was then covered with the great wash from the mountain sides, the gold seeking the bottom, the loam and soil floating to the meadows below, leaving the clay to form a new bottom for the creeks and benches and overlying the extremely rich deposits since drifted out. When the great maelstrom had ceased to whirl and grind, and the work of nature went quietly on, then the melting snows of winter and the summer rains continued the unfinished work of the glaciers by gradually washing the gold from the sides of the mountains, together with the decomposing sulphurets which the glaciers had reached and broken from the veins. The gold found in the present creek bottom on the clay, and that also found in the higher workings of the hydraulic claims, being, as a rule, much finer than that gathered from the old channel under the clay, made finer, no doubt, from its slow travelling down the mountain side. Of course, many large pieces are now found where they became lodged in the rocks or ravines during the glacial period.

The same effect, I think, was produced in California; but the cause being less violent and the mountains not being so high, the veins were not broken and worn down to depth enough to reach the sulphurets, except in some instances.

Why some veins in California continue to yield free-milling ore to a great depth, while, so far, none of any note have been found here, will be, in my judgment, as hard to explain as why, in some of the Comstock mines, the ore yields largely in gold with silver, while in mines on the same vein and not far distant the percentage of gold is small.

I will cite some of the silver mines of Mexico, notably those on the peninsula fifty miles inland from the City of La Paz.

On some of the veins the surface has been worked to a depth varying from ten to one hundred feet, for the purpose of getting the docile or so-called "patia" ore (an ore that is free milling and worked by an anastra), but at the above-named depths base ore, or so-called fire ore, is always encountered. That ore requires skill to extract the precious metals. And now that nature has been kind enough to mill the top or free-milling ore from your veins, you must employ skill, combined with intelligence, in opening and working your mines and ore, in order to make mining one of the great industries of your country.

With thirty-three years' underground experience in California, Nevada, Arizona, and Mexico, I will now state without any reserve that I have unlimited faith in the continuation of your veins to a great depth. My best guide in coming to that conclusion is the increase of the percentage of gold-bearing sulphurets as depth is attained; the ore in the two shafts that have attained a depth of one hundred feet being heavily charged with rich sulphurets, while the croppings showed but a small percentage, comparatively speaking, with more free gold visible.

CONSOLIDATION OF COMPANIES.

As all properties will not result in being mines, and to prospect any one of them properly requires time and money, I recommend that owners should, as far as practicable, consolidate and select any one of their claims, and unite their time and strength on it. When sufficiently developed, capital will then buy or incorporate with them and place the mine on a paying

basis, and they can then attack another property. Owners of prospects must not sit idle and wait for capital to come and buy a quartz boulder or a ten-foot hole in the ground.

REDUCTION OF REBELLIOUS ORES.

Although I consider the reduction of your ores the only real matter at issue, I shall not dwell long on it; as the history of gold quartz mining and milling has been reduced to a science in California, and is well known by all metallurgists, and as such men must be employed, it is not essential that I should go into details.

Your gold quartz is known as sulphuret ore—that is, from ten to seventy-five per cent. of the gold they contain is locked up in sulphurets.

I will state that the only process so far found practicable by which they can be reduced is to wet-crush the ore as it comes from the mine; most of the free gold is saved passing over the silver plates in and outside of the battery. The pulp then passes over one of the several good concentrators, or vanners, now in use. The concentrator saves from seventy to ninety per cent. of the valuable sulphurets, fine gold, and amalgam that escape the plates while the gangue passes off. The concentrations thus saved then pass into skilled hands, and are desulphurized and chloridized when the gold is readily obtained.

Where the ore is rich in sulphurets an advantage is gained in the crushing capacity of the mills, as in milling ore for free gold a wire screen of from forty-five to fifty meshes to the square inch is generally used, which allows a crushing capacity of about two tons per stamp of eight hundred pounds every twenty-four hours, while in crushing ores rich in sulphurets a screen containing about thirty meshes to the square inch is used, which gives the stamps a much greater crushing capacity. Such ores are not crushed so fine as free milling ore, as the sulphurets are easily reduced in the battery; and if a screen of from forty to fifty is used, the sulphurets would be reduced to an almost impalpable pulp, and much would pass the concentrator as slum.

Trials of the best concentrators failed recently to prevent a loss being sustained in working the silver ores of the Comstock vein, as the chlorides passed off as slum.

Mills of twenty or more stamps would, no doubt, erect their own chlorination works, and they could always be employed to reduce the concentrations of smaller mills, and the skilled labour would always find useful employment about the mill when not so employed. Wood being abundant, the ores can be handled cheaply.

I may make somewhat plainer the process of reducing your ores by chlorination. After the sulphurets are carefully concentrated they are roasted until they are thoroughly desulphurized. Through the agency of chlorine gas, per-chloride of gold is then produced. Sulphuric acid, per-oxide of manganese and common salt, are the agents by which the chlorine gas is produced. Pure water then dissolves the per-chloride of gold, which is readily precipitated into a powder or flour gold, by the aid of sulphate of iron.

PATENT PROCESSES.

I must give you warning by calling your attention to the many processes being placed before the public, or before men not skilled in such business as mining and milling ore, for they are the only ones who can be led astray into such wild and impracticable schemes as some of the processes are.

I will refer you to some of the failures, and if your memory does not serve you well in the matter, you can get full particulars from Wm. Ireland, jr., State Geologist of California.

The first one in my mind was introduced by a man, I think, named Mears, in Chili, ten or more years ago. He became the rage in that great mining country. His process was, of course, a secret. His trials, like all such, were, however, public; even those likely to fall into the trap were invited to make tests for themselves, all with good results.

Many wealthy men became bankrupt by buying mines which were too poor to be worked by ordinary process. The promoter was presumably interested in such sales. The matter became so public, and so many had invested their all, that an investigation was had, which resulted in the fraud being exposed and the promoter sent to prison, and, if alive, is, perhaps, there yet.

Among the more recent patent processes is the Frier process. Some twenty-two years ago Meadow Lake district was discovered in the Sierra Nevada Mountains, about thirty-five miles from the Central Pacific Railroad. The veins were extremely large and well-defined; many of them rich. A large town grew up, as it were, in a day; mills built and mines opened,

when, to the consternation of all, the ores were found to be refractory, and up to this time they have baffled the most skillful manipulators. About ten years ago a man named Frier gave out that he had discovered a process by which the ore could be worked. I, with many others, think that he was honest in his belief; but after men of means had spent thousands of dollars in the erection of reduction works, it proved to be an utter failure, and to this day the rich veins of Meadow Lake lie dormant. A San Francisco Company, by latest advices, are shipping in and erecting a mill to cost one hundred and fifty thousand dollars. Let us hope the mystery has been solved as to the proper treatment of the ores.

A more recent process is one started some five years ago in San Francisco, and lately revived in Victoria. I had the satisfaction of investigating it some time ago, soon after it was made public. Small works were erected in Sacramento, but never started. It was taken east, and I was told that Jay Gould and other moneyed men, all ignorant of such matters, took stock and erected works in Colorado. If so, they quietly closed them down; not one of them is at work either in California, or, to my knowledge, in any other country in the world. Every mining man in the world would hail with delight such a process if it were feasible.

I cannot well afford to make the effort I am now making on behalf of your people and Government, and see my work hampered by having some patent process sprung upon the public and proved to be an unmitigated failure, after costing individuals or the Government thousands of dollars, and the fault be laid on the mines as being valueless. I refer those that have witnessed the process, and feel anxious to investigate, to such men as Wm. Ireland, jr., State Geologist; Professor Price, Assayer and Chemist; C. A. Luckhardt, of Nevada Metallurgical Works, and H. Kustell, Assayer, all prominent men in that branch in San Francisco. Either will be pleased to give them information on the subject.

I must not let any patent process escape me for fear you may deem it applicable to your ores because I neglected to report or state my views on the subject. I therefore call your attention to an article in the *Mainland Guardian* of July 31st, 1886.

I do not deny the possibility of saving the gold by the process referred to in the article; but the very fact of the pulp or ground ore having to pass over a bath of melted copper explains at once that the ore must be dry-crushed, that process at once reduces the crushing capacity of the mill over one-fourth as compared with wet-crushing; and the same per diem cost of fuel and skilled labour goes on. Next, in order to reach the gold, all the crushed ore, sulphurets, and vein gangue alike must pass over the molten bath, which requires fuel and skill to keep to the requisite temperature, as well also does it require skill to keep the pulp passing evenly over the bath; and lastly, when your gold is gathered you must resort to the expensive method of parting the precious metal from the copper, which process alone would go far towards desulphurizing and chloridizing the ore now done in California.

DIFFERENCE IN COST OF MINING IN BRITISH COLUMBIA AS COMPARED WITH CALIFORNIA.

In the absence of statistics, I will attempt to show the difference in the cost of mining and milling in California as compared with Cariboo, and the very probable results to be obtained from the energetic, careful, and scientific handling of your large and well-defined gold-bearing veins.

Skilled labour, which includes mechanical engineers, smiths, millmen, and chloridizers, costs, in California, about four dollars per diem. First-class miners and blasters cost \$3, and second-class from \$2.75 to \$2.50; outside labour, including Chinese, averages \$2 per diem. Wood, for steam purposes, will, no doubt, average at this time \$5.50 per cord, while the ores milled do not, in my opinion, yield to exceed eight and a half dollars per ton. That estimate may seem small to a California miner, but when it is remembered the enormous quantities of low-grade ores milled by such companies as the Plumas-Eureka, Sierra Buttes, Douglas Island, Doctor Zielie Mine, and many others, it greatly reduces the average as compared with the few stamps milling \$12 to \$20 ore. And yet the far-seeing capitalist of California finds investment in a quartz mine one of his best investments, and does not hesitate to erect the best machinery that skill can invent, whereby mining may be made a legitimate branch of industry; and my examination of your veins has led me to carefully study the situation as compared with the above. I find skilled labour, as above, will, perhaps, cost \$6 per diem, good miners \$4, second-class \$3.50, while outside labour costs \$3, and wood not to exceed \$3 per cord.

While I feel safe in placing the milling value of your ores at from \$17.50 to \$20 per ton, and I feel confident that those figures can be safely advanced from ten to twenty per cent., but I have endeavoured to be cautious in the examination of your mines and my statements to

your people, and do not wish to cause them to feel over sanguine until milling results are reached. I have made the above estimates as to cost after talking with your most prominent citizens, and estimate the value of your ores after making over fifty assays from the different veins and carefully testing the feasibility of chloridizing the sulphurets contained in the ore.

MINERALOGICAL SURVEY.

I deem it of the greatest importance to the Province that a systematic mineralogical survey be made, not alone of this immediate vicinity, but of the outlying and surrounding country. The survey should be so managed as to keep pace with the prospector, rather than neglect the work commenced by extending the examination too far beyond present work; for, by extending the survey beyond present developments, you deprive the prospector of the assistance and advice of your engineer.

As I have previously stated, the Government can materially aid and assist the prospector in his work of development, and often save him much time and money by having an intelligent and practical engineer near by to consult and to advise him as to the best method to prospect his ground, and as to the probability of reaching pay ore.

In this connection I will state that I see a Bill is presented before the House in New Zealand whereby it is proposed to appropriate one hundred thousand pounds to aid in developing the mineral resources of the Colony; while the United States has, perhaps, the most complete and extensive mineralogical survey system of any country in the world, and the result is—what? English and French capital come to the United States in preference to any other country. They read and have the mineral resources of the country explained to them constantly.

Following upon the heels of the annual mineralogical report, enterprising men go to London and Paris well supplied with samples of ore and elaborate maps of mining property, and, gifted with national go-ahead-itiveness and never-let go, they annually induce a large amount of capital to come into California, Nevada, Colorado, Idaho, New Mexico, and Arizona. Not one of these States or Territories but have large English and French companies successfully at work; and the more capital they invest the better they are pleased in case it yields from six to ten per cent. per annum.

That capital can be turned hitherward; not, however, by sitting supinely waiting for its coming.

Ask an Englishman which he would prefer, Canada or the United States, and why, and he will answer—"The United States, because there is more dash, enterprise, and go-ahead amongst the people." Including Alaska, Oregon, California, Idaho, and Montana, mining industries have almost surrounded you, and the outside world scarcely knows that you are the possessors of such promising and well-defined gold and silver-bearing veins.

Several years ago so eminent a man as Professor Dawson took with him to Montreal samples of the quartz broken from the croppings of your veins, and reported to you from five to six dollars per ton, and encouraged you to hunt in those veins for richer ore, as they were, beyond doubt, the sources of the many millions of coarse gold intermixed with quartz taken from your creeks and benches, and no richer placer diggings were ever discovered than your creeks and benches through which the veins pass. Do not forget that the mountain will not come to you; on the contrary you must seek capital and give it encouragement, and the day will come when your district will again rank as formerly amongst the great gold producers.

Capital at present is seeking investment in the most remote corners of the globe. All manufacturing industries are overdone. Silver is a drug upon the market and can scarcely hold its place as a circulating medium, while (including the product of the entire world) gold enough is not now produced to supply the arts and sciences. Then why not use energy and push enough to induce English capital to come to your district?

In referring to capital seeking investment, I may refer you to the circumstance of an English company formed to work the gold quartz found in South Africa. In order to be well equipped in every detail, their mill was built in San Francisco, shipped overland to New York, thence to England, and transhipped to Natal on the South Coast, where it had to be hauled by cattle seven hundred miles inland. Also one of a hundred stamps and necessary amalgamating pans was built in San Francisco and shipped to Peru, where, by rail and mules, it had to reach the giddy height of thirteen thousand feet, near the summit of the Andes Mountains, to work a silver mine.

MANAGERS OF MILLS AND MINING PROPERTY.

I can not too strongly impress upon the minds of those proposing to invest in, or operate mines, in this district, the great importance of selecting none but the most competent of men for their managers. They should come with good references as to ability and integrity.

Favouritism, friendship, partnership, good honest men, and too old to work, and such like considerations that can be advanced for making appointments, which might lead to the ruin of a company, or, at least, the useless expenditure of thousands of dollars, should all be discarded. The day is past for appointing ministers out of place, highly educated physicians and lawyers, or rich men's sons just out of college, because their fathers are largely interested. Appoint some man who has had years of experience of vein mining, one who has cost some San Francisco or Eastern company half a million of dollars by some blunder made years ago. He has had experience, and blunders, and wonders how he could have made such mistakes as he has. He will, even now, make small mistakes, but he is quick to discover and remedy them. Good men can be procured, men that have worked in and helped to open the finest mines in the world.

A manager should be able to run an engine, know how to run a mill in all its branches, know when each stamp is doing duty, detect a loose mortar bolt, cut out any kind of timbers for shaft, drift, or elsewhere, sharp a pick or drill, and, in fact, he must be a miniature encyclopedia, and he must be honest, temperate, and kind.

TUNNELLING.

Tunnelling, as a rule, has caused disaster and ruin to many a promising mining venture, and should only be resorted to when a mine has been proved to be valuable by shafts and drifts on the veins, and then only after a careful calculation as to the difference in cost as between hoisting and pumping, and the cost of making the tunnel, always bearing in mind that when machinery of sufficient power to sink deep enough to justify a tunnel is once in place that the same machinery may have to come in play again when the ore above the bottom adit is worked out, and the difference of continuing the hoist above the tunnel and to the surface will be so small that, in rare cases only, is the tunnel a benefit. I allude to deep, and not to prospecting, tunnels.

There are cases where tunnelling would be proper, notably, on the Island Mountain mines, after they have been fully proven.

Instances can be cited where millions have been squandered on the everlasting tunnel business.

I will cite the Silver Mountain tunnels, Alturas County, California, run in to tap supposed rich mines at a great depth; when a few thousand dollars and a good horse-whim and work immediately on the vein would have proven the ground. Coming nearer home, I may refer to the Burns Mountain tunnel, the St. Laurent and American tunnels. Not one of these was started to tap a body of ore known to exist. Had the St. Laurent and American tunnels reached and tapped the vein at a pinched or barren point, Mr. R. B. Harper's statement, that the vein was a continuous and good one, would have been unjustly condemned, for it is fair to presume that drifts would not have been driven on the vein one foot in hopes of finding a pay-chute, and the owners would have, perhaps, abandoned the property. To say they were surface prospect tunnels is absurd, as a small engine could be purchased and a much greater depth reached for far less money than the tunnels could be run, with the plant in place for deeper developing.

Let the prospector endeavour to find a pay-chute and sink on it, never leaving the vein; if he can find no pay-chute on his vein, select a place, sink as deep as possible and drift on the vein hoping to find one.

All work done on the vein is useful; all work done outside of the vein has, eventually, to be paid for with cash or out of the vein when reached.

MILL SITES.

Great care and forethought should be exercised in the selection of mill sites, always aiming to have the mill below the lowest contemplated opening of the mine, then making allowance for an ore-house with capacity of from 500 to 1000 tons of ore, as, in case of accident to mine-machinery or mine, the mill will be well supplied with ore. Then, below that and the ore crusher should be bins with capacity of at least several hundred tons of ore, so as to give ample time to repair any accident to the ore crusher.

Below the ore bins come the self-feeders, one of the most useful adjuncts of the mill. Below them, and in front of the battery, come the plates and sluices; and last of all come the concentrators for the saving of the rich sulphurets and amalgam that may escape from the plates; so that it is not hard to calculate the fall necessary to select a good mill site in this country.

ASSAY OFFICE.

An assay office is an absolute necessity in a mining country, and more especially in this district.

No miner, however skilful, can tell what his ore is worth per ton by looking at the sulphurets, and he will be greatly guided by his assays. Also, in case chlorination works are erected, the purchaser and seller of sulphurets would both wish to have samples assayed.

I would recommend that an assayer be appointed to officiate in your very well arranged assay office.

SURVEYOR.

One of the most necessary and useful men in a mining district is a surveyor; one appointed by the Government; and if an assistant is required, which will undoubtedly be the case, he should be appointed by and under the Government appointee. Without a surveyor no miner is sure that he is not developing his neighbour's, instead of his own, mine. The surveyor saves endless and costly litigation.

It is true, as a rule, we did our own surveying in Nevada with shotguns, but it causes an unpleasant feeling in a mining camp.

After the prospector has done his preliminary work, and is preparing to do permanent work, he must have a surveyor. When the manager for a company has opened his mine he wishes to have an office map, or working map, of his own, to which he can add his monthly work; and also his company will wish one at headquarters, to which they can add the work as it progresses. The veins, so far as known, should be run out, and a large map of the district should be kept in your office, and its fellow in Victoria.

I cannot too strongly urge the appointment of a Government surveyor. He would draw a salary and reasonable rates be allowed him for work done for individuals or companies. In time I think the office, as well as the assay office, would be self sustaining.

EFFORTS MADE TO WORK QUARTZ MINES IN 1878 AND 1879.

The effort made to inaugurate quartz mining in 1878 was certainly laudable, and justified by so many large and gold-bearing quartz veins exposed, and while a more competent mining engineer could perhaps have been chosen, yet, I am pleased to say that Mr. R. B. Harper told you many plain truths in reference to your veins, and notwithstanding that it is possible he lacked experience as a manager he would eventually have piloted you to success. Being a mining community his mismanagement in reference to tunnels, mill sites, &c., would easily have been remedied, and I cannot possibly understand why the quartz mining industry was so suddenly dropped because another man employed by private parties condemned Harper and disdained his statements. That person was formerly connected with C. A. Luckhardt, a very eminent assayer in San Francisco, and it is fair to presume was a good metallurgist, and, in fact, he is at present conducting an extensive assay office in New York. I cannot understand why he attempted and continued to mill large quantities of ore by free-milling process when he undoubtedly knew that it was impossible to save the gold by such process. Nor can I understand why he erected a cupola furnace previous to his free-milling attempt.

In examining the furnace, I find that he roasted the ore in bulk, or broken to the size of nut coal.

All he could do, at best, would be to desulphurize the outside of each piece; but suppose he had crushed it, as he should, and desulphurized all the ore, even then he would not have succeeded in saving the gold by grinding in the amalgamating pans, simply because he failed to chloridize the ore after desulphurizing it. From my personal knowledge of the gentleman I can not believe he was ignorant of the method required and universally adopted in California.

Yet eminent Freiburgh students were, as a rule, complete failures in California and Nevada.

I think it unfortunate that Mr. Harper was not sustained, and, while I am not aware that he has had the experience, or is capable of managing a mining property, yet I am well enough acquainted with him to say that a mining company might do much worse than employ him as underground manager of their mine.

I refer to the failure of 1878-79, in order to point out that it was not the fault of the veins that such failures came about.

EXTENT OF GOLD-BEARING DISTRICT.

Owing to the short time allowed for this examination I can say but little as to the extent of your gold and silver-bearing district, and must confine myself to hearsay and my personal experience on Hixon creek (some fifty miles north-west from this point), together with my examination in this immediate vicinity. At Hixon creek the formation is very similar to that of this district. A large quantity of float quartz is found in the porphyry formation, and has formed itself into the semblance of a vein in many places without, however, taking the precaution to encase itself in regular walls, as all well-regulated veins should; in other words, the surplus or overflow from the vein proper is found as above described.

Much gold has been found in that quartz; but in bunches or in small deposits.

At the bottom of a shaft, sunk to a depth of one hundred feet, a *contact* was found; that is to say, the point of conjunction of a slate belt and porphyry. True, no vein of quartz existed at that point, but it gave encouragement to seek further. A shaft sunk to a depth of fifty feet, at a distance of one hundred and sixty feet from the former shaft, was pumped out, and, on examination, showed that while much work had been done on the quartz scattered through the porphyry, they had also drifted and tapped a true fissure, or contact vein, at a point of contact of slate and porphyry.

It was quite encouraging, and it was decided to prospect further in hopes of finding a pay-chute of quartz.

Being near the creek it was deemed best to sink and prospect at another point distant about fifty feet. A shaft was sunk, and at a depth of sixty feet a drift was started, and the vein was found at the exact point where it was estimated to be, and no vein in California has truer or better defined walls. It is quite possible a greater depth must be reached before paying quartz in large quantities will be obtained. Recent advices, however, are exceedingly encouraging, much rich quartz being now raised.

I have dwelt to some extent on this special property in order to show to the satisfaction of all that your gold-quartz deposits of this district are not local, but that a regular and unbroken formation exists, and continues for many miles, and that true fissure and even contact veins of gold and silver ore can be found by intelligent prospectors.

Mining, when conducted on the same principles of economy, and with the same business caution and foresight as are necessary in manufacturing ventures, and other enterprises requiring investment of capital, is not more risky than other branches of industry, and I predict that the result of intelligent planning, patient and energetic work will demonstrate that that branch of industry can be as successfully carried on in Cariboo district as in any other district on the Pacific coast.

With timber in abundance and a climate equally good with that of Idaho and Montana, and veins of ore from five to twenty-two feet in width, what should prevent your district from being ranked among the gold producers? Surely no reason can be assigned why such veins will not pay if they will yield ten dollars to the ton, where much lower grade ore is mined and milled in California at a profit, with the cost as between the two countries so evenly balanced.

I will conclude by giving you an extract from a letter from C. A. Luckhardt, Esq., Nevada Metallurgical Works, San Francisco, now in the hands of Mr. Joseph Mason, Barkerville, showing that after having worked samples of the ore sent from this district, he coincides with my statement as to the proper method of working your ores:—

"It is impracticable to amalgamate the ore raw. This ore wants to be run through a 'battery' (crushed), concentrated on a 'Frue' or other concentrator, and the concentrations 'want to be roasted and the gold extracted by elorination to obtain a good practical result.'"

I remain very respectfully yours,

(Signed) GEO. A. KOCH.

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PARLIAMENT 1980